

# PATENT ABSTRACTS OF JAPAN

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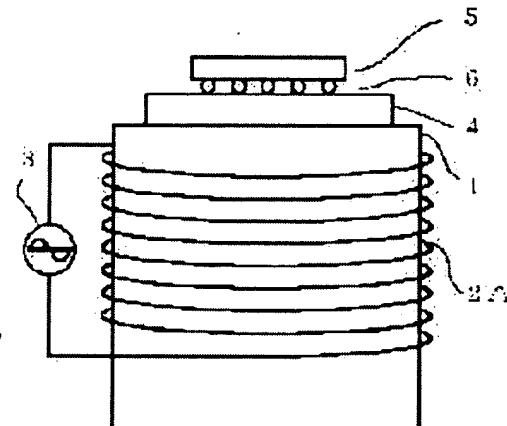
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## (54) HEATER FOR MOUNTING SEMICONDUCTOR CHIP

### (57) Abstract:

PROBLEM TO BE SOLVED: To reduce waste of energy for melting solder bumps in flip-chip mounting and prevent a circuit board from being deformed due to heating.

SOLUTION: A heater comprises a ferrite-made heater block 1, a heating coil 2A wound around the block 1, and a high-frequency power source 3 connected to the coil 2A. In the flip-chip mounting, a circuit board 4 and a semiconductor chip 5 are mounted on the heater block 1, a high-frequency current is fed to the heating coil 2A, which then generates high-frequency flux to induce eddy current in the heater block 1, thus heating the heater block 1. Since the high-frequency induction heating having a short rise time is used, solder bumps 6 are molten, and this suppresses the waste of energies except those required and also the rise of the ambient temp., thereby preventing the circuit board from being deformed due to heating.



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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

**[Field of the Invention]** This invention is heating apparatus used in case semiconductor chips, such as IC, are mounted in the circuit board, and relates to the heating apparatus used in case the electrodes of a semiconductor chip and the circuit board are connected especially face to face.

**[0002]**

**[Description of the Prior Art]** Since it responds to a request called the miniaturization of a product in recent years, the so-called flip chip bonding is used. In flip chip bonding, after alignment of the electrode of a semiconductor chip and the electrode of the circuit board is carried out face to face, it has touched on both sides of the solder bump. And a pressure and heat are impressed and electrodes are electrically connected by hardening, after a solder bump fuses. In order to impress a pressure and heat to a semiconductor chip and the circuit board, heating apparatus like a cartridge heater is used. Drawing 3 is the explanatory view of the flip chip bonding which used the conventional heating apparatus. On a stage 10, the circuit board 11 which consists of a printed circuit board etc. is laid. And after the electrode (with no graphic display) of the circuit board 11 and the electrode (with no graphic display) of a semiconductor chip 12 counter and alignment is carried out, the solder bump 13 beforehand formed on the electrode of a semiconductor chip 12 is inserted, and the electrodes of the circuit board 11 and a semiconductor chip 12 touch. Furthermore, the field in which the electrode is not prepared in the semiconductor chip 12 is pressurized by the heater block 14 which used the cartridge heater, and is heated. Thereby, the solder bump 13 fuses and the electrodes of the circuit board 11 and a semiconductor chip 12 are connected electrically.

**[0003]**

**[Problem(s) to be Solved by the Invention]** However, since it takes time amount to become predetermined temperature after powering on in using the above-mentioned conventional heating apparatus, in order to raise working efficiency, it always changes heating apparatus into the energization condition. In addition, the heat conducted from the cartridge heater is radiated on a perimeter from the heater block 14. Therefore, since heating apparatus radiated heat also to fields other than the need while generating heat also in the time amount which originally is not required, electrical energy was to be wasted. Moreover, since it generates heat in the time amount and the field which originally are not required, the ambient temperature of the heating apparatus circumference rises. When impressing heat required in order to carry out melting of the solder bump by this, the temperature of the circuit board rose and there was a possibility that deformation of the curvature of the circuit board by heat etc. might occur.

**[0004]** This invention is made in order to solve an above-mentioned technical problem, it makes energy saving possible, and aims at offering the heating apparatus which prevents deformation of the circuit board by heat.

**[0005]**

**[Means for Solving the Problem]** In order to solve an above-mentioned technical technical problem,

while having a fixed means for the heating apparatus concerning this invention to be heating apparatus for semiconductor chip mounting used in case the electrode of a semiconductor chip and the electrode of the circuit board are connected electrically, and to fix the circuit board, it is characterized by induction heating of the fixed means being carried out by the high frequency current.

[0006] Moreover, the heating apparatus concerning this invention is heating apparatus for semiconductor chip mounting used in case the electrode of a semiconductor chip and the electrode of the circuit board are connected electrically, and while having a fixed means to fix the circuit board, and a press means for carrying out the pressure welding of the semiconductor chip to the circuit board, it is characterized by induction heating of the press means being carried out by the high frequency current.

[0007]

[Function] What is necessary is according to this invention, just to switch on the power source of heating apparatus, just before heating a semiconductor chip and the circuit board since induction heating by the high frequency current is used. This does not radiate heat to the field which does not need to be heated in the time amount which does not need to be heated essentially. Therefore, while being able to control waste of energy, since lifting of the ambient temperature of the heating apparatus circumference is controlled, deformation of the circuit board can be prevented.

[0008]

[Embodiment of the Invention] (1st operation gestalt) The 1st operation gestalt of this invention is explained hereafter, referring to a drawing. Drawing 1 is the explanatory view of the flip chip bonding which used the heating apparatus for semiconductor chip mounting concerning this operation gestalt.

[0009] In Drawing 1, the heater block 1 is established so that it may consist of a ferrite and a top face may become level. Heating coil 2A is a coil which surround the heater block 1 and is rolled, and is connected to RF generator 3. The circuit board 4 which consists of a printed circuit board is laid in the top face of the heater block 1. And alignment of the solder bump 6 prepared on the electrode (not shown) of a semiconductor chip 5 was carried out to the electrode (with no graphic display) of the circuit board 4, and she is in contact with it.

[0010] In using the heating apparatus for semiconductor chip mounting concerning this operation gestalt, after laying the circuit board 4 on the heater block 1, carrying out alignment of the semiconductor chip 5 and laying it on the circuit board 4 further, the high frequency current is impressed to heating coil 2A. Thereby, an eddy current is guided to the heater block 1 by the magnetic flux which is the high frequency which heating coil 2A generates. Therefore, since the circuit board 4 which the heater block 1 generated heat and was laid in the top face of the heater block 1 is heated, the solder bump 6 fuses and the electrodes of a semiconductor chip 5 and the circuit board 4 are connected electrically.

[0011] Time amount required since the description of the heating apparatus for semiconductor chip mounting concerning this operation gestalt goes up to predetermined temperature is a very short thing. For example, time amount required in order to carry out temperature up from a room temperature to 200 degrees C is good in about 3 seconds.

[0012] Therefore, what is necessary is according to this operation gestalt, just to impress the high frequency current to heating coil 2A, after laying the circuit board 4 on the heater block 1 actually. Therefore, waste of energy can be controlled. Moreover, since heating time is suppressed to the minimum, the time amount by which lifting of the ambient temperature of the heating apparatus circumference is prevented, and the circuit board 4 is exposed to an elevated temperature can be shortened. Therefore, deformation of the circuit board by heat can be prevented.

[0013] (2nd operation gestalt) The 2nd operation gestalt of this invention is explained hereafter, referring to a drawing. Drawing 2 is the explanatory view of the flip chip bonding which used the heating apparatus for semiconductor chip mounting concerning this operation gestalt.

[0014] In Drawing 2, the circuit board 4 is laid on a stage 7, and on the circuit board 4, a semiconductor chip 5 carries out alignment of the electrodes (with no graphic display), and is laid. On the electrode of a semiconductor chip 5, the solder bump 6 is formed beforehand. That is, alignment of the solder bump 6 prepared on the electrode of a semiconductor chip 5 was carried out to the electrode of the circuit board

4, and she is in contact with it. It serves both as a pressure-welding tool and a heating tool, and consists of a ferrite, for example, an underside has the configuration and size according to a semiconductor chip 5, and the heater block 8 is established so that it may become level. Heating coil 2B is a coil which surround the heater block 8 and is rolled, and is connected to RF generator 3.

[0015] In using the heating apparatus for semiconductor chip mounting concerning this operation gestalt, sequential installation of the circuit board 4 and the semiconductor chip 5 is carried out on a stage 7, and it impresses the high frequency current to heating coil 2B. Thereby, like the 1st operation gestalt, by the magnetic flux which is the high frequency which heating coil 2B generates, an eddy current is guided to the heater block 8, and the heater block 8 generates heat. After that, the pressure welding of the semiconductor chip 5 is carried out to the circuit board 4 with the heater block 8.

Therefore, by the heated heater block 8, since the semiconductor chip 5 by which the pressure welding was carried out is heated, the solder bump 6 fuses and the electrodes of a semiconductor chip 5 and the circuit board 4 are connected electrically.

[0016] Time amount required [ the heater block 8 goes up to predetermined temperature ] in this operation gestalt as well as the 1st operation gestalt is very short. Therefore, what is necessary is just to impress the high frequency current to heating coil 2B, after laying the circuit board 4 on a stage 7 actually. Therefore, waste of energy can be controlled. Moreover, since heating time is suppressed to the minimum, the time amount by which lifting of the ambient temperature of the heating apparatus circumference is prevented, and the circuit board 4 is exposed to an elevated temperature can be shortened. Therefore, deformation of the circuit board by heat can be prevented.

[0017] in addition, the stage in which the circuit board is laid in each operation gestalt explained above - or although the heating coil was prepared only in the pressure-welding tool which carries out the pressure welding of the semiconductor chip, it is good also as structure of preparing the both sides of a stage and a pressure-welding tool a heating coil, and heating a semiconductor chip and the circuit board directly, respectively.

[0018] Moreover, although the printed circuit board was used as the circuit board, the circuit board of the shape of a film which consists not only of this but of polyimide etc., and has flexibility, and the so-called flexible substrate (Flexible Circuit) may be used.

[0019] Moreover, although the configuration which prepared the solder bump beforehand on the electrode of a semiconductor chip was explained, it may replace with this, the conductive resin which mixed the particle of Ag-Pd as conductive matter may be used, and the conductive matter may be further prepared beforehand on the electrode of the circuit board.

[0020] Furthermore, Au plating is beforehand performed to the electrodes of the circuit board and a semiconductor chip, and where the pressure welding of the electrodes is carried out, after applying thermosetting resin to the perimeter of a semiconductor chip, thermosetting resin can also be stiffened using the heating apparatus for semiconductor chip mounting concerning this invention. In this case, electric connection of electrodes is secured with the stress of the hardened resin.

[0021]

[Effect of the Invention] According to this invention, in the heating apparatus for semiconductor chip mounting, since a semiconductor chip and the circuit board are heated using induction heating by the high frequency current, only the time amount which needs to be heated truly should operate [ heating apparatus ]. Since this does not radiate heat on the time amount which does not need to be heated essentially to the field which does not need to be heated, waste of energy can be controlled. Moreover, since lifting of the ambient temperature of the heating apparatus circumference is controlled, deformation of the circuit board can be prevented. Therefore, the outstanding practical effectiveness [ say / that the heating apparatus for semiconductor chip mounting which controls waste of energy and prevents deformation of the circuit board can be offered ] is done so.

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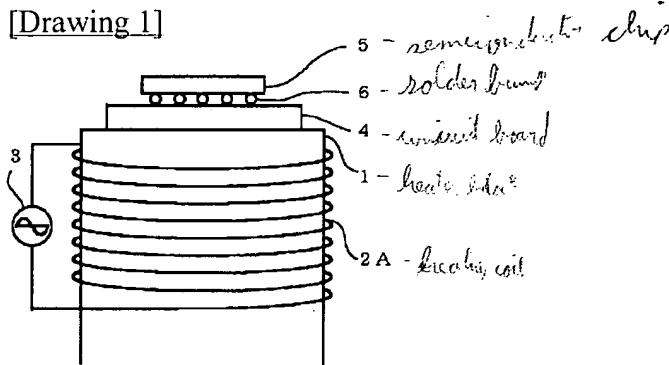
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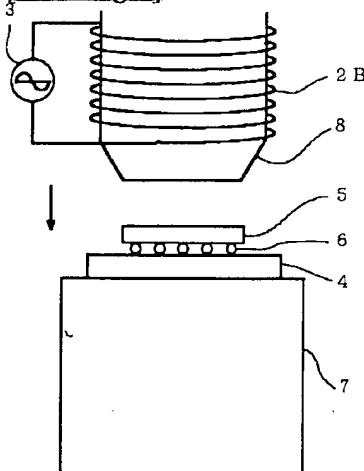
DRAWINGS

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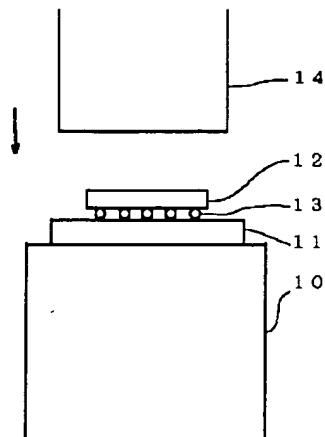
[Drawing 1]



[Drawing 2]



[Drawing 3]



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